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AUTHOR	Wang, Hongxue; Holt, Pete
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ABSTRACT

This paper deals with the design of an integrated system for Web-based distance education (ISWBDE). At the highest level, this system can be dissected into two sub-systems: an integrated course authoring system (ICAS) and an integrated course delivery system (ICDS). The ICAS is designed to help with, or automate the creation and management of curriculum, learning objects, and courses, whereas the ICDS is designed to generate personalized courses for individual students, to provide an integrated online learning environment on students' computers, an integrated tutoring environment for tutors and an integrated coordinating environment for course coordinators. The focus of this paper is on the design of the whole system, rather than the implementation. (Contains 16 references.) (Author)

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The Design of an Integrated System for Web-based Distance Education

Hongxue Wang and Pete Holt
Centre for Computing and Information Systems
Athabasca University
1 University Drive, Athabasca, AB T9S 3A3
Canada
{harrisw, holt}@athabascau.ca

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ABSTRACT

This paper details the design of an integrated system for Web-based distance education (ISWBDE. At the highest level, this system can be dissected into two sub-systems: an integrated course authoring system (ICAS) and an integrated course delivery system (ICDS). The integrated course authoring system (ICAS) is designed to help with, or automate the creation and management of curriculum, learning objects, and courses, whereas the integrated course delivery system (ICDS) is designed to generate personalized courses for individual students, to provide an integrated online learning environment on students' computers, an integrated tutoring environment for tutors and an integrated coordinating environment for course coordinators. The focus of this paper will be on the design of the whole system rather than the implementation, since we don't have enough space for those details.

1. INTRODUCTION

Distance education is an effective way "to remove barriers that traditionally restrict access to and success in university-level studies, and to increase equality of educational opportunity" (Athabasca University, 2002), and the World Wide Web is the most effective way to get people connected across almost any distance. Thus, Web-based distance education has become so far the best form of distance education, and is becoming a fast growing market worldwide.

As usual, Web-based distance education involves two phases: course development and course delivery. In the course development phase, an academic program including a detailed curriculum must be proposed, evaluated and fully developed according to the overall commitment and available resources of the institution as well as the current educational market. There are also other issues involved in program curriculum development and management such as credential and compatibility with programs offered in other institutions. Given a fully developed program, professors or subject matter experts can then plan, design and author each course in the program curriculum. The first thing in writing a particular course is obviously to define what a course is, or what should be included in a course package. This must be done at the beginning of a course development.

In the delivery phase of developed courses, it is generally required that instructors, tutors and students should work together in order to achieve certain designated teaching and learning goals. The detailed tasks for instructors, tutors and students to carry out in course delivery phase may be essentially different, however. So the first thing that must be done before a course can be offered or even developed is to decide what the instructor should do, what the tutors should do, and what the students should do, and most importantly, how.

In Web-based distance education neither of these two phases is an easy task. Therefore, it is important for institutions that offer web-based courses to provide course developers with some tools to automate the development of Web-

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based courses or as assistance, and to provide instructors, tutors and students some tools to accomplish their teaching and learning tasks over the World Wide Web.

In this paper we present the design of an integrated system for Web-based distance education that provides educators with support in both Web-based course development and delivery, and provides students with an integrated software environment to learn, to communicate with instructors, and to collaborate with others in both peer-to-peer and group mode. We will also recommend and describe certain important strategies and techniques necessary for the implementation. We will also explain the rational of each proposed functional module and recommended strategy and techniques for the implementation.

1.1 The integrated system as a whole

The whole integrated system we are developing is intended for upgrading or enhancing our existing course development and delivery system by providing instructors with an integrated system for course development and authoring, and providing instructors with an integrated teaching environment to teach, and providing students with an integrated system to accomplish their designated learning tasks, and to achieve the desired result. Accordingly, the whole system can be divided into two subsystems: an integrated course authoring system (ICAS), and an integrated course delivery system (ICDS). These two subsystems overlap at course server that takes input from the course authoring sub-system (ICAS), and makes output to the course delivery sub-system (ICDS).

In the following section we will describe details of these three parts of the integrated system for web-based distance education: the course authoring subsystem, the course delivery system and the course server that joins the above two subsystems together. We do not use the term e-learning here because we consider what we are doing now is closely relevant to the entire distance education system, of which learning is only a part.

2. The Design of Integrated Course Authoring System

In this section, we first detail the design of an integrated course authoring system, then outline some technical details on how the system should be implemented. The structure of the system is shown in Figure 1.

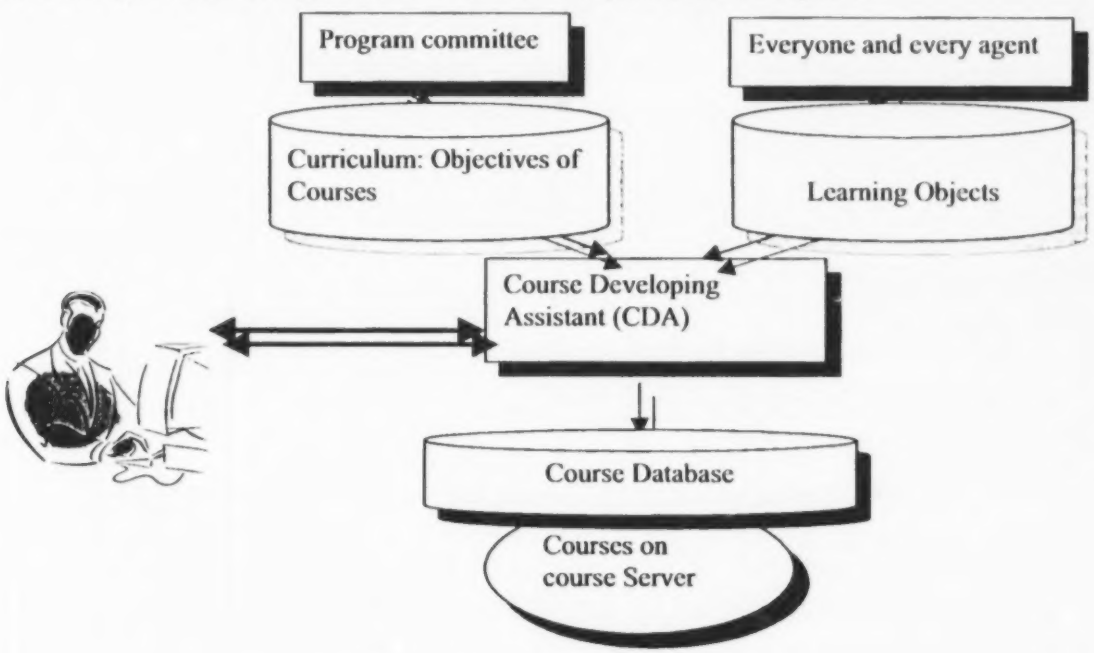

Figure 1: Structure of the integrated course authoring system

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The ICAS system is based on two essential databases: a database of course or program objectives set up by the program committee and maintained by the program coordinator based on IEEE or ACM curriculum, a database of learning objects developed by a variety of people and software agents. A course is an association of course objectives with learning objects, and should be organised in accordance with certain widely agreed pedagogical approaches.

Therefore, the course developing assistant (CDA) should be design to help professors to: find out the right coverage of a course, create a list of units, then sections for each unit, and for each section generate a list of section objectives and then choose appropriate learning objects from the learning objects database. The CDA should also be able to automatically generate course study guide and all other files as well as data sets in the course database.

3. The Design of Integrated Course Delivery System

The integrated course delivery system consists of three parts for instructors/coordinators, tutors and students respectively. The relationships between these three systems are shown in Figure 2.

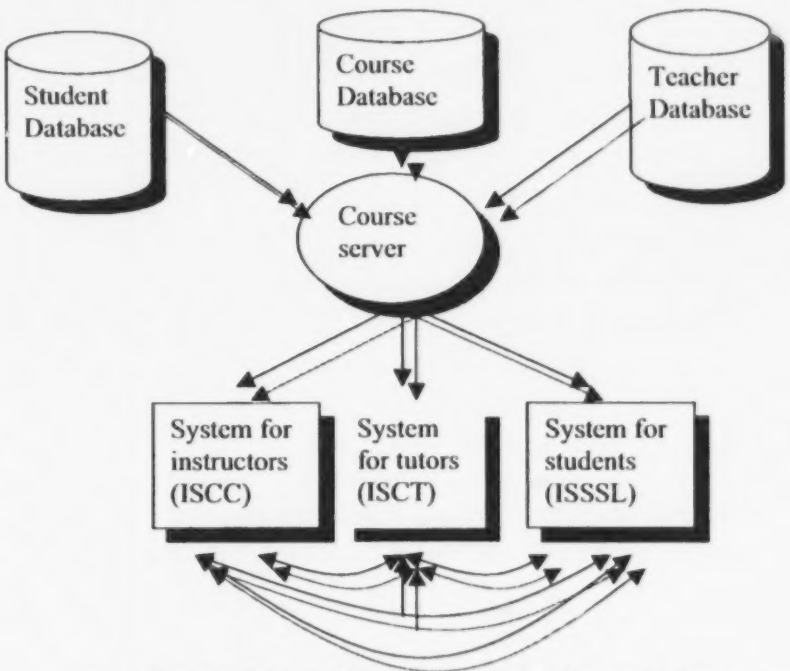

Figure 2: Relationships between course delivery subsystems

It should be noted that within our integrated course delivery system the three subsystems can interact with each other in both peer-to-peer and group fashion.

3.1 ISCC: INTEGRATED SYSTEM FOR COURSE COORDINATORS AND TUTORS

In Web-based distance education there is no face-to-face real-time instruction. As such, course coordinators often play roles of both coordinators and instructors in traditional universities. These roles include, but not limited to, *a.* assess students' qualification for course registration and make decisions accordingly; *b.* answer all hard questions and queries from students and even tutors; *c.* control the quality of teaching and learning by discovering and preventing plagiarisms, ensuring satisfactory performance of both tutors and students, continuously improving and quality and accuracy of course material including quizzes, assignments and exam questions.

To help course coordinators in accomplishing their jobs, our integrated system for course coordinators include the following modules:

1. ***Course presentation module***
   This module is essential to our integrated system. With this module not only course material marked in XML can be parsed and rendered with whatever output devices available on the user's computer. Learning objects including simulation and other course-specific programs can also be rendered in an effective way.

   In terms of network-related system performance and security, there is nothing to worry about, although some programs and simulation images will be of big size and can be more capable of doing things on client machines than traditional applets. The main reason is that most course materials such as course-related programs and images will be packed in the course package and downloaded by students only once, such as when a student has decided to start the course work. Later in the process of taking the course some updates or patches may be necessary for downloading from the course server, but that will not happen so often.

2. ***Course maintenance module***
   This module is responsible for assisting course coordinators to find inconsistency in course material, validate hyperlinks, identify and locate mistakes in the course material, and when capable automatically update course material based on coordinators' instruction and received messages.

3. ***Course messaging module***
   This module is similar to general email client such as Netscape messenger or Microsoft Outlook, but built into our integrated system for course coordinators (as we shall see shortly similar course messaging module is also built into integrated systems for tutors and students). The big advantage of developing and using such a built-in or specialized messaging module is that messages can be shared and manipulated by other modules easily. Also, some software agents can be easily built and deployed within such a specialized messaging module. Among these possible agents, an automatic question answering agent or FAQ agent will be most helpful since answering hard questions from students and tutors is an important duty of course coordinators.

4. ***Course conference module***
   While messages posted using the above messaging module are read and kept by the recipients and maybe the senders, messages posted at the course conference will be stored in a central server, and accessible to all course participants including coordinators, tutors and students. As usual, these messages will be threaded, and processed by some software agents for further actions such as course update, question answering. Although course conference is a place of open discussion about the course mainly for students, course coordinators do need to pay their attention to some hard questions. Technically speaking, the simple way to help course coordinators in this is to build a software agent into the conference module. What the agent is supposed to do is help identify those hard questions and send them to tutors or the course coordinator via the course messaging module, where some automatic question answering agents have already built.

5. ***Students assessment module***
   This module assesses both registered students and potential students who are seeking for professors' approval. The purposes of assessing a student registered in the course are: to identify potential plagiarism by checking the inconsistency among the results of quizzes, assignments and exams; to decide student's final grade; to evaluate the quality of the course by doing various statistics on student learning records. If the coordinator is also tutoring the course, assignment grading and management function should also be activated.

   To assess the qualification of a potential student, this module will simply communicate with the student seeking for missing information about his/her background knowledge and work experience, then compare with the course prerequisites. The assessment, and the data used in this assessment will be kept in a different database initially, but can be migrated to database for registered students.

6. ***Tutors assessment module***

As usual, a course coordinator is also the person, if not the only one, who is responsible for assessing and monitoring the performance of course tutors. The assessment is based on students' evaluation, statistics over messages in the course messaging and conference module.

7. ***Task scheduling and monitoring module***

It can be easily imagine that course coordinators will have lots things to do. It is sometime very hard to decide when to do what without missing certain deadlines. The task scheduling and monitoring module is designed to identify questions to answer, emails to reply, and other tasks a course coordinator should complete and schedule these tasks for the coordinator, and monitor the progress of accomplishment.

The structure of ISCC including the relationships between the modules mentioned above is illustrated in Figure 3.

The integrated system is designed for use in a centre or department, and there is no such an integrated system at the university level yet. Therefore, until then messages from university registry and student administration regarding students, either in the course or merely interested in taking the course, will be sent to course coordinator at a regular email address, and be filtered and copied to a specific local file folder to which ISCC can access. These messages will then be processed by a parser for further decisions. Since students and tutors are all using their version of integrated systems, messages from tutors and students can be easily handled within the integrated course delivery system (ICDS).

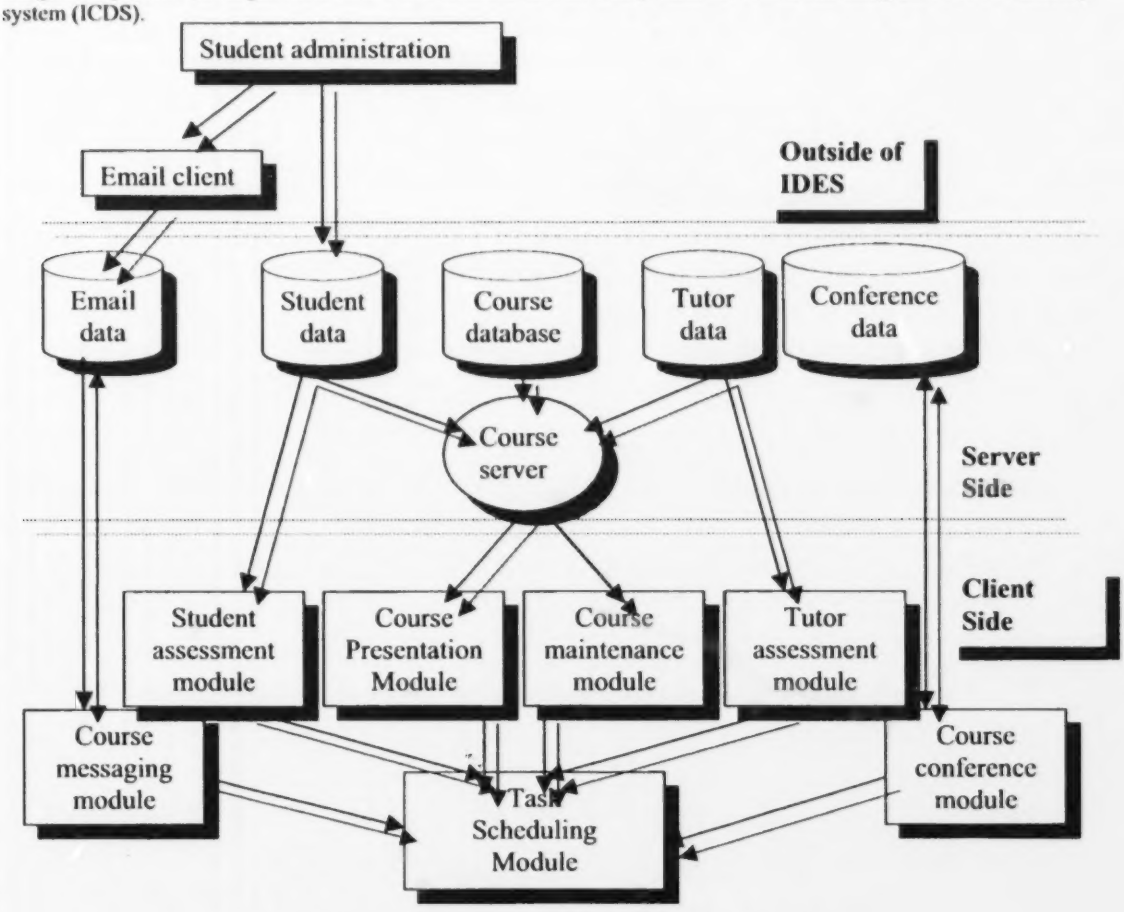

Figure 3: Structure of integrated system for course coordinators

The integrated system for course tutor also includes a course presentation module, a course-messaging module, a course conference module, student assessment module and a task scheduling and monitoring module. The function and the design of the first three modules are similar to that of ISCC. The function of student assessment module for tutors, however, is different from the module for course coordinators. Course tutors are responsible for marking student assignments while the course coordinator is generally not unless s/he is also tutoring the course. Therefore, the course assessment module for tutors needs to be able to help tutors in managing and marking student assignments. These may include, for example, retrieving student assignments from somewhere, or accepting student submission of assignments, reminding tutors to mark assignments, and record the marks. The plagiarism detection facility can also be built into ISCT for tutors.

3.2 ISSSL: INTEGRATED SYSTEM TO SUPPORT STUDENT LEARNING

The ISSSL is designed to bear the following features to support students learning:

- Be able to present a variety of learning objects to student.
- Presented course material should be personalized
- Learning progress can be self monitored by a student.
- If needed, a virtual lab can be provided to students to accomplish their learning task.
- Allow a student to communicate with course coordinators, tutors and other students, and the communication can be traced and followed up.
- Allow both peer-to-peer and group collaboration, etc.

Based on modules we have discussed so far in the two previous subsections, some of these features can naturally provided within some of the modules it can share with ISCC and ISCT. These modules are: course presentation module, course messaging module and course conference module. While the courses presentation module will focus on XML for creating and processing specialized educational tag sets, it will also include players for 3D and multimedia presentations. Likewise the messaging module will give students the option of email, instant messaging, whiteboard, and chat). For students two new modules have to be provided within ISSSL: a module that can help students to schedule their learning tasks and monitor the learning progress and a module for identifying and selecting suitable peer collaborators. The design for integrated system to support student learning is shown in Figure 3 on the last page of the paper.

4. Discussions

We have presented in this paper the design of a specialized integrated system for Web-based distance education presents. Compared with systems based on general-purpose Web browsers, one of the advantages of a specialized system is that we shall be able to present all kinds of course material to students including programs for simulation and virtual lab and other sophisticate functions. One more function may be possible is to implement a online exam module within ISCC and ISSSL by utilizing video camera connected to student computers.

5. ACKNOWLEDGEMENT

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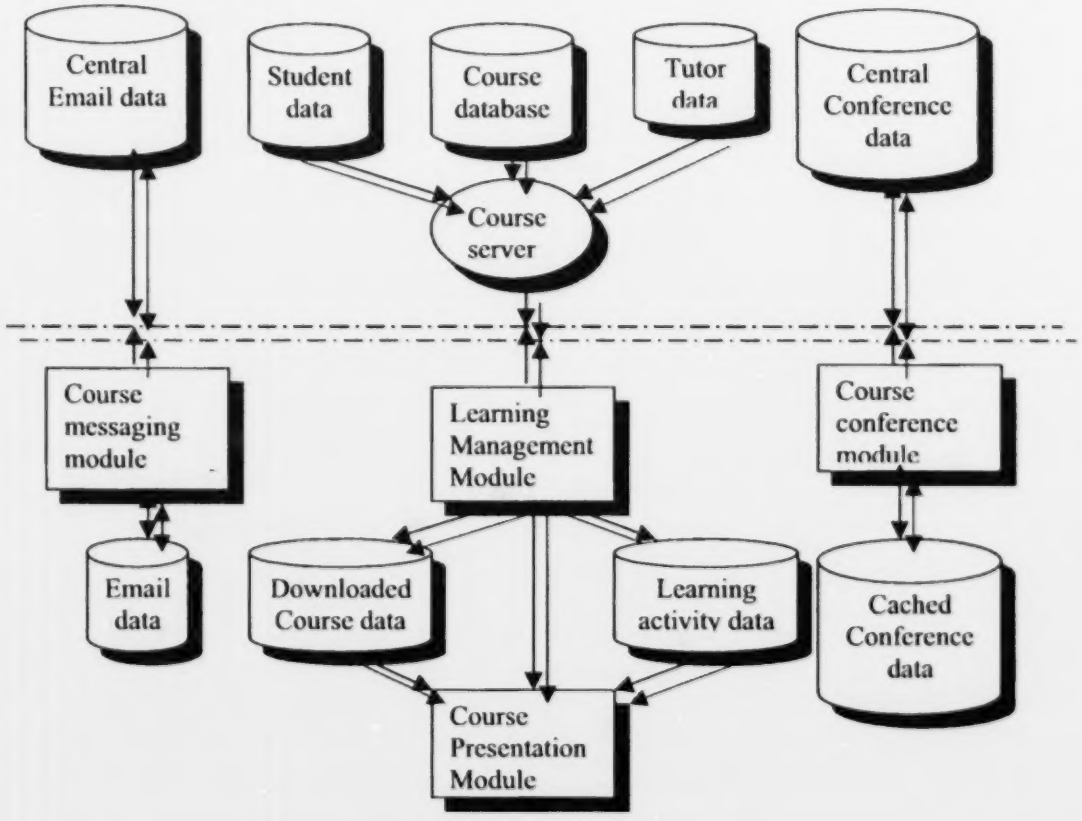

Figure 4: Structure of Integrated System to Support Student Learning

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